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## Physiological aspects of the hemiparasite *Rhinanthus serotinus*

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## SUMMARY

The hemiparasite *Rhinanthus serotinus* (Schönh.) Oborny, the yellow rattle, is capable of autotrophic existence, but in nature it occurs only in the parasitic state. When *Rhinanthus* plants are grown without a host, in the laboratory, the plants in general remain small and stunted. The growth is stimulated enormously after attachment, by means of haustoria, to the roots of a host plant. The questions of the limiting factors for the growth of *Rhinanthus* without a host are:

- 1) Is the absorption of water and/or minerals limiting?
  - 2) Is the synthesis of certain organic compounds limiting?
- To find an answer unattached and attached *Rhinanthus* plants were compared.

The hydrostatic pressure in the xylem is lower in *Rhinanthus* than in the host *Hordeum* before attachment and increases as a consequence of the formation of an open xylem-xylem connection between host and parasite. Apparently, the water transport to *Rhinanthus* is facilitated after attachment. The hydrostatic pressure remains lower than that of the host. This indicates a resistance to water transport in the haustoria and accounts for the flow of water and solutes in the direction of the parasite. Water and solutes are absorbed by the cells, which increase in size. The turgor pressure rises steeply. The osmotic pressure is hardly affected.

The contents of nitrogen, phosphorus, potassium, magnesium, and sodium increase considerably after attachment, whereas the content of calcium decreases. The root growth of *Rhinanthus* is not stimulated after attachment and, thus, does not keep pace with the accelerated growth of the shoot. It is apparent, therefore, that the dependence of *Rhinanthus* on the host for water and minerals increases accordingly.

The dependence on the host for the supply of assimilates is restricted to the earliest stages after attachment. In these stages the content of chlorophyll, the content of RuDP-carboxylase, and the rate of photosynthesis decrease. In later stages *Rhinanthus* is self-supporting with respect to carbohydrates.

A stimulative effect of hormones from the host on the growth of *Rhinanthus* was not found. Kinetin appeared to stimulate the formation of "pseudohaustoria", which suggests that cytokinins from the host are involved in the induction of haustoria.

The results suggest that in unattached *Rhinanthus* growth is limited by a discrepancy between water absorption by the roots and water loss by the leaves. This is probably caused by excessive loss of water by secretion through the numerous glands on the leaf surface. Thus, the activity of the leaf glands is an advantage after attachment, but a disadvantage before attachment.

It was found that the growth inhibition can be reversed by a large supply of inorganic nutrients. The water stress in the vessels is not relieved under such conditions. An increased supply of minerals enables the cells to enhance their osmotic pressure and to absorb more water from the xylem.

Apparently, in the normal habitats of *Rhinanthus* the supply of minerals to the roots is insufficient to compensate for the water stress. Here the plant must have recourse to parasitism to survive.